The detailed exposition of Grassmann's system is excellent and will be welcomed by all who wish to assimilate the ideas of that great master of space-analysis. The last book of the present volume is on the application of the calculus of extension to geometry, and it is evident from the fourth chapter, entitled 'On Pure Vector Formulæ,' that the author considers vector analysis to be supplementary to quaternion analysis. They are not the same thing; and both gain when it is perceived that they are not redundant, but supplementary to one another.

In conclusion, the work reflects great credit on the author and on the Cambridge University Press; it is likely to lead to further advances in Universal Algebra, not only by what it lays down, but by the questions which it brings forward for discussion.

ALEXANDER MACFARLANE.

The Principles of Agriculture. By L. H. BAILEY. New York, The Macmillan Company. 1898. Pp. xx + 300.

'Principles of Agriculture,' by Professor L. H. Bailey and his associates in Cornell University, is a new volume in the Rural Science Series and in many respects is the most important one of the series, as it serves as an introduction to the others. The book is intended to be used as a text-book for schools and rural societies, but it will prove interesting and valuable for the agriculturally inclined who have had little or no training in the natural sciences. It is essentially a book for beginners, and as such serves its purpose better than any of the small handbooks which have attempted to treat of the elementary principles of agricultural science.

The volume is edited by Professor Bailey and some of the chapters are written by him; the remaining chapters are written by his associates, who are specialists in the departments of which they have written. At the end of each chapter are suggestions which serve to elucidate the text for readers whose knowledge of natural science or of rural affairs is scanty, and also give useful hints for teachers who may use the volume as a text-book.

In the introduction we are told that "agriculture is not itself a science, but a mosaic of many sciences, arts and activities, or, a composite of sciences and arts, much as medicine and surgery are. * * * But the prosecution of agriculture must be scientific." The aim of the book is to deal with 'fundamentals' rather than 'incidentals.' "The mistake is often made of teaching how to overcome obstacles before explaining why obstacles are obstacles. * * * The purpose of education is to improve the farmer and not the farm." Would that more of our farmers could see the truth contained in these statements.

The book opens with a brief treatment of the formation of the different kinds of soils. On page 27 the author says: "The profit in agriculture often lies in making the soil produce more abundantly than it is of itself able to do." On page 202: "In intensive and specialty farming manures may be bought." These statements are true, but do not consist well with what is said about ideal agriculture on page 2. Inorganic compounds are explained as those which are not produced by living organisms, and phosphoric acid is given as one example, notwithstanding that a large amount of phosphoric acid used in commercial fertilizers is made from bone. Although the chemists call it an inorganic compound, yet because it is found in the remains of animals the reader who has had no knowledge of chemistry might be puzzled until some further explanation was made.

The second chapter, which is written by Professor Spencer, shows what is meant by 'texture' of the soil, why good texture is important and how to obtain it. That "the texture or physical condition of the soil is nearly always more important than its mere richness in plant food" is a fact not recognized by some tillers of the soil.

The 'moisture of the soil' and 'tillage' are next treated in a brief and creditable manner. Several figures are given to illustrate the art of plowing and one of an 'ideal general purpose plow.' All plowmen will think that this implement might be improved upon, but the low handles should be appreciated by everyone. The handles of many plows are too far from the ground.

Chapters IV. and V. treat of enriching the

soil. The former explains the method of handling home-made manure, while the latter has to do with commercial fertilizers only. Fig. 31 shows a 'common type of barnyard,' in which home-made fertilizers are allowed to go to waste, while in Fig. 30 is shown a model method of protecting them; yet the position of the watering trough is not an ideal one, looking at it from a sanitary point of view. Fig. 32 shows a 'handy and economical stable,' which, in reality, is anything but desirable. It might do for a makeshift while refitting an old barn, but it cannot be recommended to anyone who is planning to erect a new set of buildings.

Other chapters deal with plants, their propagation and subsequent care. It is misleading to say that germs or bacteria may cause constitutional troubles in the plant, as is done on page 167 and again on page 170, where we read that constitutional diseases are usually treated by burning the affected parts, which implies that such a plant may spread the disease if not destroyed. It is hard to see how a disease inherent in a plant (constitutional) can spread the disease to other plants, unless the affected parts of the diseased plant are used for propagation. Bacterial diseases may affect the internal structure of the host, although 'the cause of it is not apparent on the exterior,' yet such diseases are not constitutional any more than the diseases caused by the Peronosporiaceæ. Some biologists deny that there are any true constitutional diseases, while here we have constitutional diseases treated as something different from contagious diseases, but what that something is is not very clear.

The life-history of one parasitic fungus given in detail would have been a valuable addition, for it would have helped much to explain *why* it is that one plant can cause sickness in another, a fact which is hard for any person to understand who has not viewed microscopic preparations of fungi. In doing this the author would have followed out the aim 'to seek why before seek how,' as stated on page 15.

Contact insecticides is a better term than 'caustic insecticides,' for in many cases the insecticide clogs the breathing pores and causes death by suffiocation rather than by caustic action on the tissues. Figs. 70 and 71 pretend to show sucking and biting insects respectively, but the reader will not be able to see the distinction from the illustrations.

Many farmers would think twice before following the advice on page 187: "If the meadow fails to return two tons of field-dried hay to the acre, plow it up," for there are local conditions where less than two tons per acre may be a justifiable crop.

Chapter XIV., 'How the Animal Lives,' by Professor Law, and Chapter XV., 'The Feeding of Animals,' by Professor Wing, give summaries of our present knowledge of subjects of which our farmers, as a rule, do not know nearly so much as they should.

The last chapter, on the 'Management of Stock,' is by Professor Roberts. On page 266 he says that there are two theories respecting the number of animals to be kept on a farm. The fact is we are beyond the theory stage in this matter, and it can be said curtly that there are two methods, the practice of either one of which must depend upon local conditions.

The severest criticism to be made of the book is that nearly every subject discussed in it is treated in too brief a manner, a result inevitable in trying to expound the principles of agriculture in one book of only 300 small pages, printed in large type. This defect has been partially remedied by references to other literature for further study, although it is to be regretted that these references are confined mainly to the work of the editor's immediate associates. The arrangement of the contents is excellent, and on the whole the book is superior to any of its kind.

In closing, we quote again from the preface: "Agriculture is a business, not a science. * * * Business cannot be taught in a book like this; but some of the laws of science as applied to farm management can be taught."

ELISHA WILSON MORSE.

Elementary Zoology. By FRANK E. BEDDARD. New York, Longmans, Green & Company. 1898. 12mo. Pp. vi+208. 93 illustrations.

Every teacher examines with interest any new text-book dealing with the subject in which he gives instruction, and his interest is all the greater if the book is written by a recog-